

Open arthrolysis versus arthroplasty in the treatment of posttraumatic elbow stiffness

Dinu M. Antonescu, Dragos Schiopu, Ioan Cristian Stoica

Foisor University Hospital for Orthopaedics and Traumatology, Bucharest, Romania

ABSTRACT

Elbow stiffness is a common problem following trauma to the elbow.

Sixty-seven patients with posttraumatic elbow stiffness were surgically treated between 1985 - 2000. Sixty-one were clinically reviewed after a mean follow-up of 15 years (range: 7 to 19 years). The initial trauma had resulted in 8 intrinsic, in 31 extrinsic and in 28 mixed lesions. The mean preoperative flexion – extension arc of motion, was 46°. After an unsuccessful conservative treatment, open surgical arthrolysis was performed in 59 patients with exclusively extrinsic or mixed lesions, through a lateral approach combined with a medial approach when deemed necessary. In patients with complex intrinsic lesions was performed 3 resection arthroplasty and 5 total elbow arthroplasty.

At final follow-up, the mean arc of motion of the elbow was significantly improved to 100° in 56 patients who had undergone open arthrolysis; 3 were lost to follow-up. Among the 3 patients who had undergone arthroplasty resection, only one had a markedly improved elbow function with a 90° arc of motion; elbow stiffness had recurred in the other two patients. Of the 5 patients who underwent total elbow arthroplasty, 3 were lost to follow-up; the other 2 patients had a stable elbow, with a fair arc of motion of 60° and 70° respectively, both with a flexion contracture of 20°. Complications included 2 superficial infections, which healed following conservative treatment, and one fracture following remodeling of a malunited distal fracture of the humerus.

In the treatment of the posttraumatic stiffness of the elbow, the arthrolysis and the arthroplasty are indicated in dependence on the existent (extrinsic or intrinsic) lesions and on their severity.

Keywords: normal arc of motion of the elbow, functional arc of motion of the elbow, elbow stiffness, arthrolysis, resection arthroplasty, endoprosthetic arthroplasty

INTRODUCTION

Limitation of the motion of the elbow is a fairly common problem following intraarticular or peri-articular fractures about the elbow. The functional disability associated with a stiff elbow depends on the severity of the reduction in range of motion. Even though the normal arc of motion of the elbow is from 0° (complete extension) to 140° (complete flexion), preservation of mobility between 30° and 130° (Morrey's functional arc of motion) is sufficient to perform most daily activities [1]. Only in special cases, for example in gymnasts or in heavy workers, may the loss of 10° to 15° of extension represent a problem. For Park et al. a flexion contracture of the elbow should be less than 20° in order to be cosmetically acceptable [2].

However, a more severe stiffness may impair the function of the hand, which is closely dependent on the flexion and extension of the elbow and on the rotation of the forearm. A 50% reduction in elbow motion can result in a loss by nearly 80% of the functional ability of the upper limb [3].

Loss of motion of the elbow following local trauma is difficult to prevent and to treat. The complex articular congruity of the elbow joint, with the presence of three joints in a single articular capsule, the fact that the articular surface and the capsule are in close proximity to the ligaments and the extracapsular muscles, as well as the occurrence of heterotopic ossification are only some of the factors which frequently lead to the development of posttraumatic stiffness of the elbow [4,5].

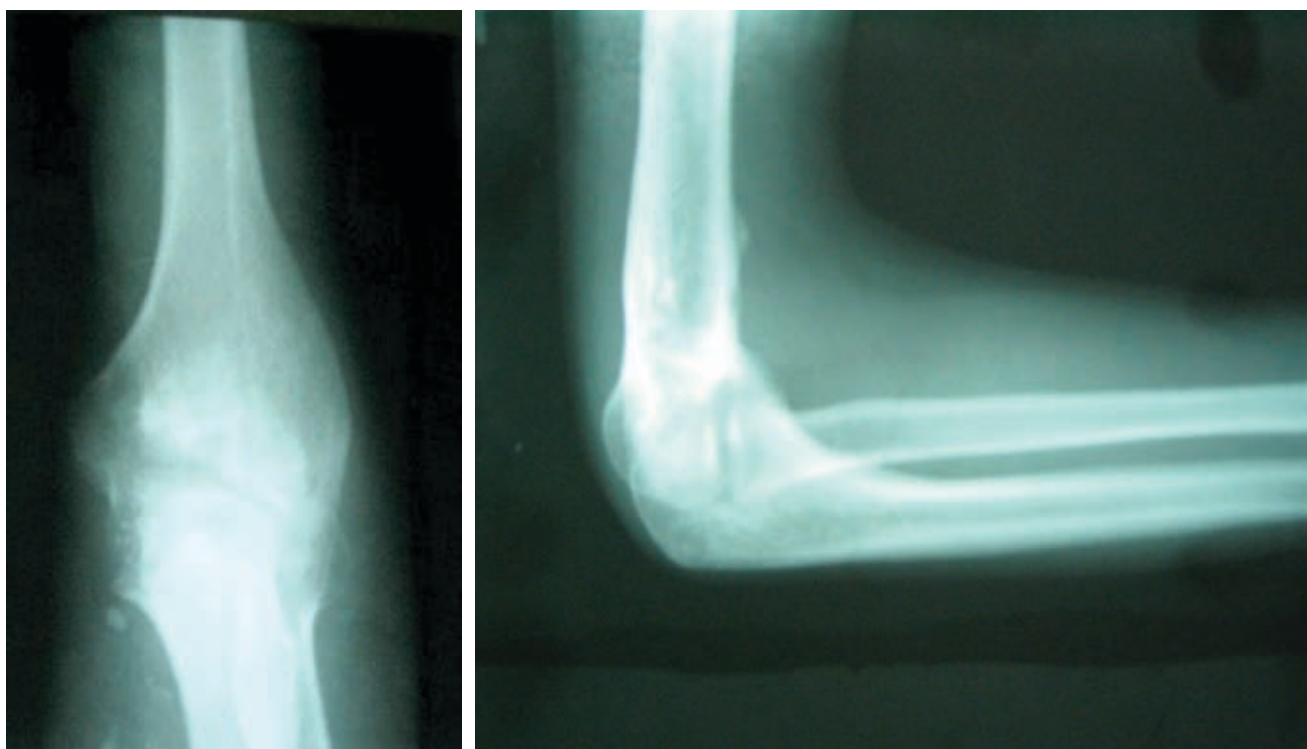


FIGURE 1. a - Intrinsic lesions of the elbow; b - Intrinsic lesions of the elbow (lateral)

PATIENTS AND METHODS

During the time period 1985-2000, 67 patients with posttraumatic elbow stiffness were surgically treated in our institution. Sixty-one were clinically reviewed after a mean follow-up of 15 years (range: 7 to 20 years). According to Morrey's classification [6], the initial trauma had resulted in intrinsic lesions (Figure 1) of the elbow joint in 8 patients, in extrinsic lesions (Figure 2) in 31 patients, and in mixed lesions (Figure 3) in 28 patients.



FIGURE 2. - Extrinsic lesions of the elbow

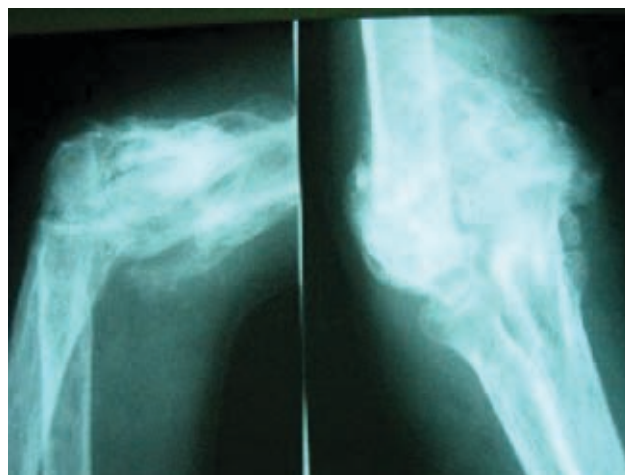


FIGURE 3. - Mixed lesions of the elbow

The mean preoperative flexion – extension arc of motion, was 46° (range: 35° - 60°). Our patient cohort includes 67 patients, 39 males and 28 females, aged 17 to 65 years (mean age: 36 years). Elbow stiffness occurred following supracondylar fractures of the humerus in 15 patients, intercondylar (T or Y) fractures in 25 patients among which 7 with severe comminution of the articular surfaces, unicondylar (lateral or medial) fractures in 16 patients; in 6 patients, the index injury was a radial head fracture and in 5 others, a fracture of the olecranon. The stiff elbow was in the dominant arm in 37 patients and in the non-dominant arm in 30. The mean preoperative flexion – extension arc of motion, was 46 degrees (between a mean 90° flexion (range: 60° to 135°) and a mean 44° flexion contracture (range: 5° - 75°). There

was a mild restriction of supination or/and pronation movement. In 32 patients, extrinsic lesions were present with preservation of intact articular surfaces; 8 patients had severe intrinsic lesions with marked narrowing of the joint line; in 25 elbows, mixed extrinsic and mild or moderate intrinsic lesions were detected; according to Morrey's classification [6].

The time interval between fracture and surgical treatment averaged 21 months (range: 10 to 117 months). Surgery was only resorted to after at least 6 months of an intensive rehabilitation treatment, which proved to be inefficacious. Surgical arthrolysis, as described in 1944 by Wilson [7], was used in 59 patients with isolated extrinsic lesions or with mixed extrinsic and mild or moderate intrinsic lesions. A progressive arthrolysis was performed, initially through a limited lateral approach which was extended as necessary and was combined with a medial approach if deemed necessary when the required mobility was not achieved through the lateral approach (17 cases) and in patients with clinical evidence of ulnar nerve involvement (the nerve was transposed anteriorly in 11 patients). The release was directed toward the anterior, or/and posterior capsule and toward any bony prominences which might contribute to the limitation of flexion, or toward the olecranon (resection of its tip) if it limited extension, in order to preserve the collateral ligaments and the extensor and flexor muscles; in other patients, a predominantly lateral, more rarely medial, muscular and ligamentous release was performed, with transosseous reinsertion without tension, of a disinserted musculo-ligamentous flap. Muscle lengthening was avoided, with rare exceptions: oblique transection of the anterior brachialis muscle was performed in 2 patients, and triceps lengthening in 3 others. Postoperatively, after a first period during which we used alternative utilization of splints in extreme positions (maximum flexion, maximum extension), continuous and progressive passive mobilization was adopted as tolerated, with immobilization in a splint at 90° flexion between the rehabilitation sittings), followed rapidly by assisted active mobilization.

In elbows with severe intrinsic lesions (8 patients) we performed resection arthroplasty in 3 patients

and prosthetic arthroplasty with a semi-constrained prosthesis in 5 patients. Resection arthroplasty as well as endoprosthetic arthroplasty were performed through a posterior approach, care being taken to preserve the lateral and medial epicondyles of the humerus with their ligamentous and muscular insertions.

The study was conducted in accordance with the Helsinki Declaration and was approved by the ethics committee of Foisor Hospital.

RESULTS

The first evaluation of the postoperative results was made at 12 months. Long-term results were assessed on average 15 years after surgery (range: 7 to 20 years). For the analysis of results we used Student's t-test. A p-value < 0.05 was considered significant.

Three patients in the arthrolysis subgroup were rapidly lost to follow up. In the other 56 patients undergoing open surgical arthrolysis, the amplitude of mobility of the elbow acquired intra-operatively was found to be of prime importance. The mean arc of motion was 115 degrees immediately after surgery; it had declined to 100 degrees after 12 months, but still showed a significant improvement ($p < 0.05$), compared to the preoperative elbow motion. The mean flexion angle at final follow up was 125° (range: 95° to 135°) with a mean flexion contracture of 25° (range: 0° to 40°).

Similar to Heirweg and De Smet [8], we achieved better postoperative results if the operation was performed less than one year after the index trauma and if the elbow presented with exclusively or predominantly extrinsic lesions. No correlation was noted between the gender and age of the patients and the result of surgery. The improvement in elbow mobility was maintained over the mean follow-up of 15 years, (Figure 4) except in 4 older patients who developed osteoarthritis over time.

In the other 52 patients, there was an increase in the flexion – extension arc of motion from 46° (range: 44° to 90°) preoperatively to 100° (range: 25° to 125°) at final follow up. Subjective or objective elbow instability was present in none of these patients.

Although restoration of Morrey's functional arc of motion was not fully achieved in all of them, all patients expressed their satisfaction with the improvement achieved. Postoperative stiffness had recurred rather early in 5 cases, due to infection (2 cases), to a supracondylar fracture after remodeling of a malunion (1 case) or due to rehabilitation difficulties (2 cases). In 2 patients, postoperative transient pares-



FIGURE 4. - Amplitude of mobility after open surgical arthrolysis

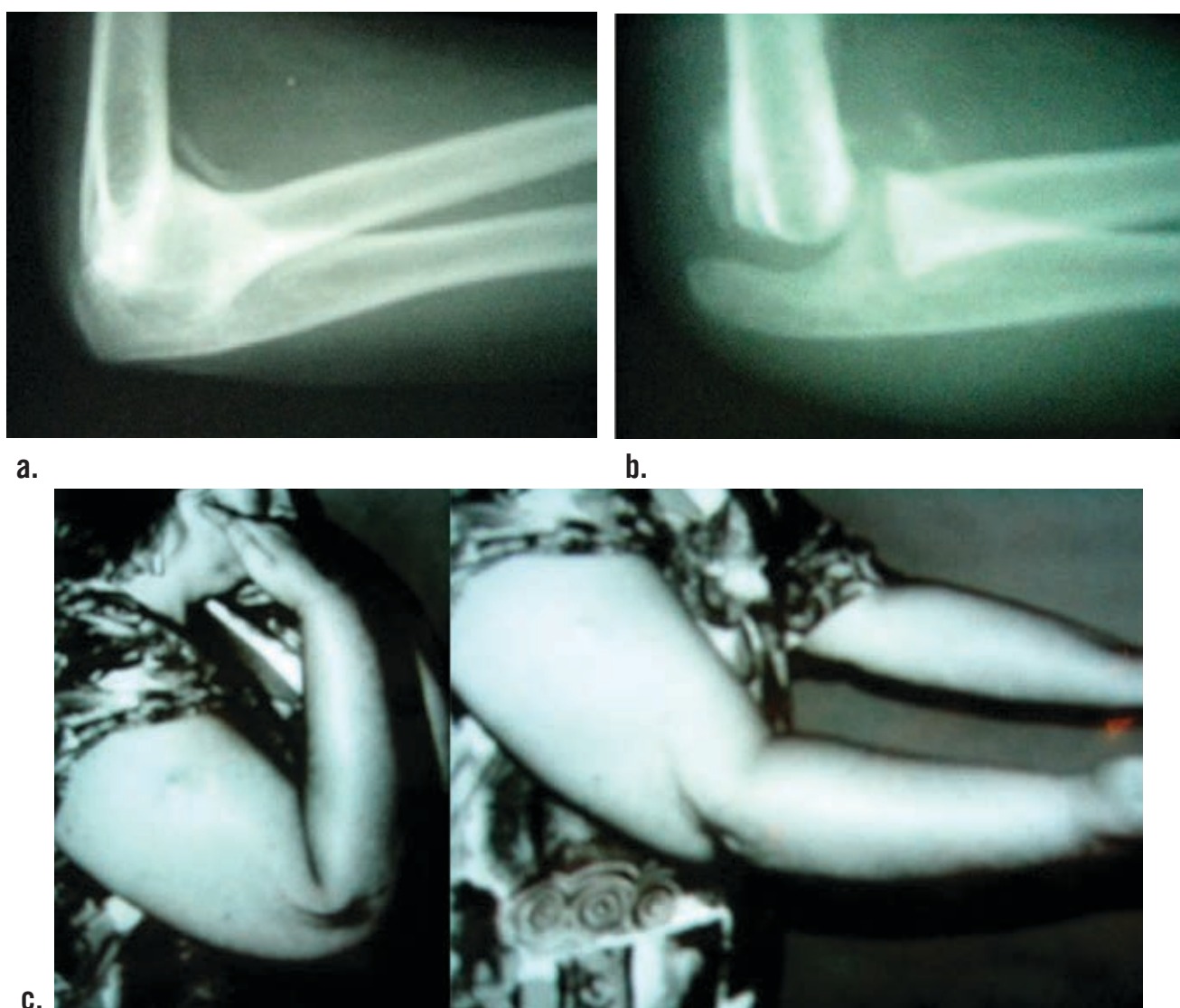


FIGURE 5. - a - preoperatively X-ray; b - after resection X-ray; c - after resection amplitude of elbow mobility

thesia appeared in the territory of the ulnar nerve, which did not interfere with the rehabilitation.

Following resection arthroplasty, the long-term results were fair, with a marked instability of the elbow in one patient, a poor mobility in another and a favorable outcome regarding elbow mobility, with a subjectively tolerable instability, in one patient (Figure 5). Reduction in muscle strength was noted in all of these patients.

Three older patients in the endoprosthetic arthroplasty group were lost to follow-up: one of them had a postoperative fracture of the distal humerus shortly after operation (Figure 6), another patient had loosening of the prosthesis after 8 years, and the third patient had transient paraesthesias in the territory of the ulnar nerve. The other two patients had a mobile, stable and painless elbow (Figure 7).

DISCUSSION

Several treatment options are currently available to address post-traumatic stiffness of the elbow.



FIGURE 6. - Fracture of the shaft of humerus



FIGURE 7. - a - preoperatively X-ray; b - X-rays after endoprosthesis arthroplasty

Stiffness of short duration, especially in children and adolescents, can be treated conservatively with good results [9,10], although some studies found that the results of physical therapy were unpredictable [11].

Arthroscopic release of the elbow is currently more and more used, essentially in arthrofibrotic elbows. It reportedly achieves good results, with a less invasive technique, and more rapid and easier rehabilitation [8,12,13,14]. However, this technique is not without risk, and it may encounter difficulties if the fibrosis is very severe and the working space for the arthroscope and instruments is very narrow. The results are also highly operator-dependent, and require an experienced arthroscopist who has come out of his learning curve. Moreover, an arthroscopic technique cannot be considered in cases in which material used for fracture fixation is to be removed [3,11].

After performing open surgical arthrolysis, the presence of severe intrinsic lesions of the osteoarticular surfaces imposes either an interposition arthroplasty, or the use of an external fixation device, with (distraction arthroplasty) or without distraction of the joint [6,15]. Hotchkiss and An reported good results using the Ilizarov technique [16]. In older patients with major damage to the osteoarticular surfaces, total elbow arthroplasty may be preferred [17]. Although endoprosthesis elbow arthroplasty is sometimes the only option to improve pain and function, this procedure may be associated with complications which may be difficult to address, including infection, extensor mechanism dysfunction, periprosthetic fractures, wear, loosening and osteolysis, as reported by Sanchez-Sotelo [18].

Open surgical arthrolysis currently remains the gold standard for the treatment of post-traumatic stiffness of the elbow [11]. Several surgical approaches have been described and used for arthrolysis of the elbow, posterior [2], anterior [4,5], lateral [19,20,21], extensile lateral approach [22,24], medial [23], bilateral [25]. The choice of a specific approach may be related to the presence of scars from previous operations, the nature and location of the original lesion, the associated compression of nerves [2]. We had used only a lateral approach, similar to Mansat and Morrey's "column procedure", and extended as necessary, combined with a medial approach in cases with symptoms suggesting ulnar nerve compression. We obtained an important gain in mobility of the elbow, in line with previous similar studies [11,21,22,23,25,26].

Following a comprehensive literature search including thirty publications reporting on 798 patients, Koddle et al. [20] made a comparison between: 1. open arthrolysis, 2. arthroscopic arthrolysis, 3. open arthrolysis with external fixation and 4. Open arthrolysis with distraction arthroplasty. The gain in range of motion was 51°, 40°, 88° and 56° for groups 1 – 4 respectively. On the other hand, the complication rates were respectively 23%,

5%, 73%, and 58% for groups 1 – 4. The group with the most important gain in mobility (open arthrolysis with external fixation) also had the highest complication rate. Release of the stiff elbow can be achieved using various techniques; as the complication rate appears to increase with more invasive techniques, it may be wise to rely whenever possible on relatively less invasive procedures [20].

In the treatment of the posttraumatic stiffness of the elbow, the arthrolysis and the arthroplasty are not alternative or competitive methods, but, on the contrary, they are complementary procedure, indicated in dependence on the existent (extrinsic or intrinsic) lesions and on their severity.

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